PATENT SPECIFICATION

DRAWINGS ATTACHED

1,145,612

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Int. Cl.:—F 01 d 25/26.

COMPLETE SPECIFICATION

Improvements relating to steam turbines

We, LICENTIA PATENT-VERWALTUNGS-G.M.B.H., a German Company having its registered office at Frankfurt/Main, Theodor-Stern-Kai 1, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to steam turbines.

In steam turbines it is important to keep to a minimum the relative displacement between the casing section carrying the guide blading and the rotating shaft. This is especially important in the low pressure stage.

It is already known, in large low pressure casings of the multiple shell type of construction, to fix the casing insert direct to the external casing. Since the inner casing, or the casing insert, and the turbine shaft are subjected to differing thermal expansions, the clearance between the guide blading and the rotating blading will vary over the total operating range Consequently the clearance between the fixed and the rotating parts must embrace the total load range of a turbine plant, and can therefore exhibit the most favourable adjustment only for the most frequently used range. The clearance, which for this reason must be designed to be large, will therefore enter into the efficiency of the system as a negative factor, particularly in the partial load ranges. This fact will be evident in a particularly unfavourable manner if the entire installation is so large that a plurality of low pressure casings are necessary, whose rotors are rigidly coupled together. The casing which is the most remote from the common thrust bearing will then exhibit the largest amount of clearance between the rotating blading and the guide blading, at least in the partial load range.

The main object of the invention is to provide an improved arrangement which avoids these disadvantages.

The present invention comprises a steam turbine having an outer casing and a casing insert supporting the stator blading, expansion members between the outer casing and the casing insert permitting relative axial expansion between the casing and the casing insert, the expansion members comprising axially extending tubes each at one end rigidly connected to the casing insert and at the other end coupled with axial clearance to a bushing secured to the outer casing said tubes being formed with ports in the walls whereby hot steam can circulate through the interiors of the tubes.

The advantage of the invention consists in the result that with such arrangements the clearance between the guide blading and the rotor blading can be maintained almost constant over the total running range of the turbine plant. By allowing steam to circulate through the interiors of the tubes it is possible to ensure that the expansions of the tubes follow fairly closely that of the rotor shaft.

With turbine plants having a plurality of low pressure casings, whose rotors are rigidly connected together, it is of particular advantage to interconnect the casing inserts by means of expansion tubes arranged between the outer casings, and to connect only that casing insert which is adjacent the common thrust bearing with its associated casing through an expansion tube.

In order that the invention may be more clearly understood reference will now be made to the accompanying drawings in which:

Figure 1 shows the manner in which a casing insert is connected through an ex-

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pansion tube to the outer casing.

Figure 2 shows by reference to graphic representation the relationship between the expansion of the casing insert, the expansion tube, the outer casing and the shaft.

Figure 3 shows the expansion of the casing insert and the casing with respect to the shaft in a previously known method of fixing the casing insert with respect to the outer casing.

Figure 4 shows the application of the invention to a turbine having a multiple casing low pressure stage.

Figure 5 shows graphically the course taken by the expansion of the casing inserts, the outer casing and the expansion pipes with respect to the rotating shaft in an arrangement according to Figure 4.

In Figure 1 one of the plurality of expansion tubes which connect the casing insert 1 to the outer casing 2 is indicated by the reference 3. This expansion tube is rigidly connected to the casing insert 1 through a support device 1*a*, and at the other end is inserted with axial clearance in the bushing 5 rigidly connected to the support console 4. The outer casing 2 has its fixed point at 2*a*. The expansion tube 3 is provided with ports 6 and 7 for heating by steam.

The graphical representation in Figure 2 shows at 21 the course taken by the curve for the expansion of the casing insert, whilst 22 shows the curve for the expansion of the outer casing. The line 23 represents the expansion curve of the expansion tube 3 and 24 shows the curve for the expansion of the rotor shaft. In this graphical representation 22*a* indicates the fixed point of the outer casing.

As compared with this, Figure 3, which refers to known arrangements, indicates at 31 the expansion curve of the casing insert, 32 the curve for the expansion of the outer casing and again, for comparison purposes, the curve for the expansion of the rotor shaft is indicated by 34. In this case the fixed point of the outer casing is indicated by 32*a*. In this manner it is clearly recognisable how the relative displacement, indicated by the variable value $\triangle l$, diminishes when using the subject matter of the invention.

Figure 4 shows the arrangement of the low pressure section of a turbine plant consisting of three low pressure casings. In this case the casing inserts 41 are connected together through connecting rods 48 and expansion tubes 43. In this arrangement it is only the casing insert 41 which is adjacent the common thrust bearing 49 which has a connection to the surrounding outer casing 42, through expansion tubes 43.

In Figure 5 there is shown, for the purpose of supplementing the showing in Figure 4, the course taken by the expansion curves of the individual low pressure sections, such as the casing insert, the outer casing, the expansion tubes and the connecting rods. In this Figure, 54 indicates the expansion curve of the rotor shaft, whilst 51 indicates the curves for the expansion of the casing inserts 41, 53 shows the curves for the expansion of the expansion tubes 43 and 58 shows the expansion curves for the connecting rods 48. 52 indicates the expansion of the outer casing 42. 52*a* symbolises the fixed point of the outer casing. By such a type of arrangement it is therefore possible to obtain the condition in which the relative displacement between the rotating parts and the fixed parts remains almost constant over the length of the entire rotor shaft.

WHAT WE CLAIM IS:

1. A steam turbine having an outer casing and a casing insert supporting the stator blading, a plurality of expansion members between the outer casing and the casing insert permitting relative axial expansion between the casing and the casing insert, the expansion members comprising axially extending tubes each at one end rigidly connected to the casing insert and at the other end connected with axial clearance to a bushing secured to the outer casing, said tubes being formed with ports in the walls whereby hot steam can circulate through the interiors of the tubes.

2. A steam turbine having the low pressure stage arranged as claimed in claim 1.

3. A steam turbine as claimed in claim 2 in which the low pressure stage has a plurality of casings each with an insert, the inserts being interconnected through rods permitting relative axial expansion of the inserts and only the insert adjacent the thrust bearing being connected to its associated casing.

4. A steam turbine substantially as herein described with reference to Figure 1 of the accompanying drawings.

5. A steam turbine substantially as herein described with reference to Figure 4 of the accompanying drawings.

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Agent for the Applicant.

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FIG.1

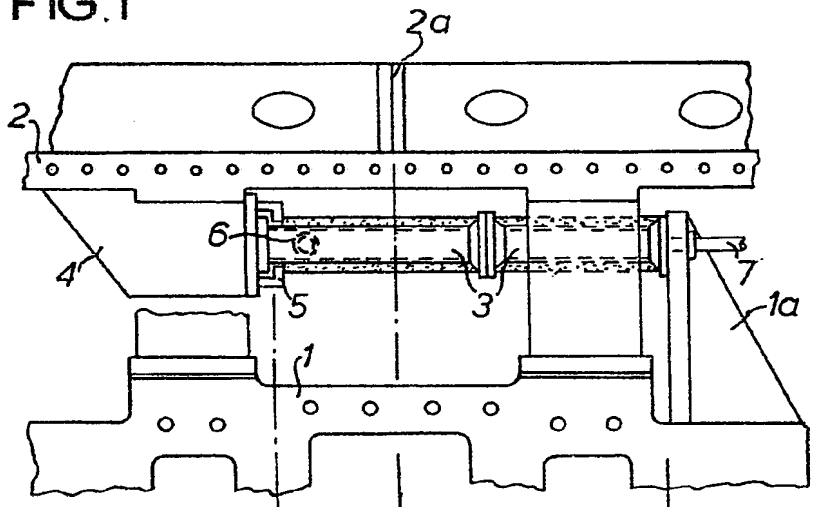


FIG.2

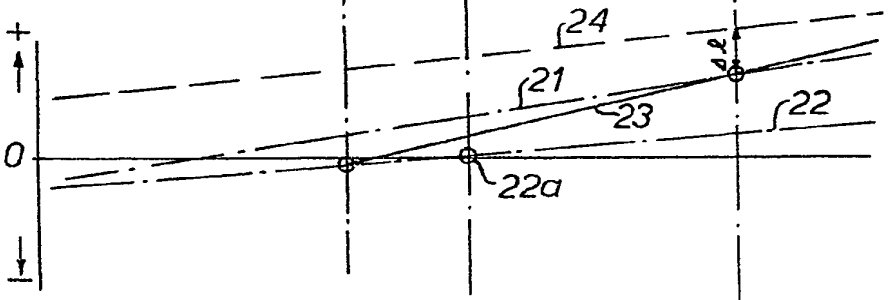
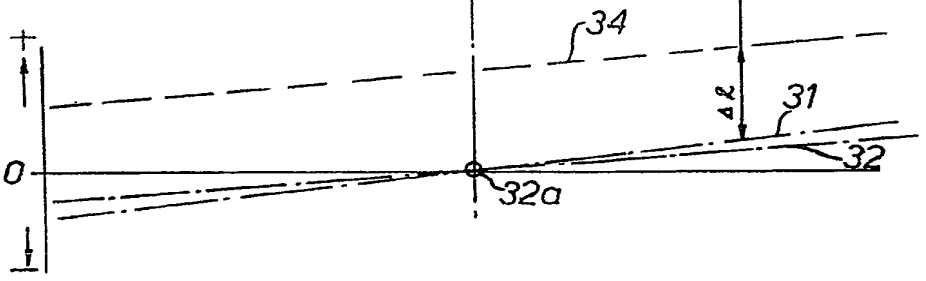


FIG.3



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SHEETS 1 & 2

FIG.4

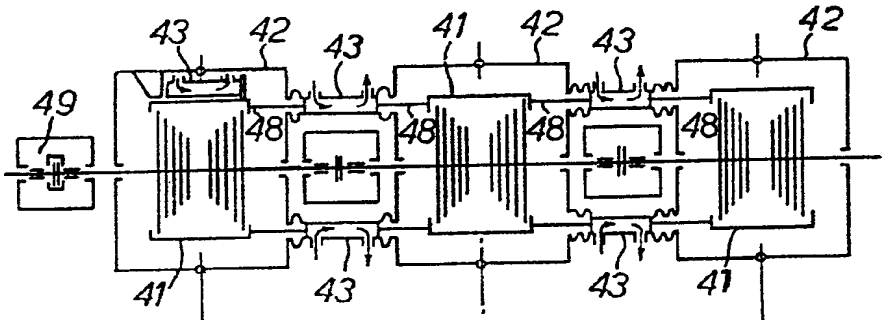
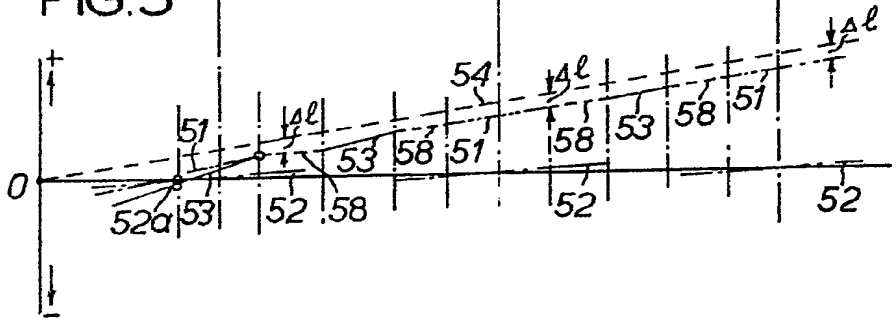


FIG.5



1,145,612 COMPLETE SPECIFICATION
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SHEETS 1 & 2

FIG.1

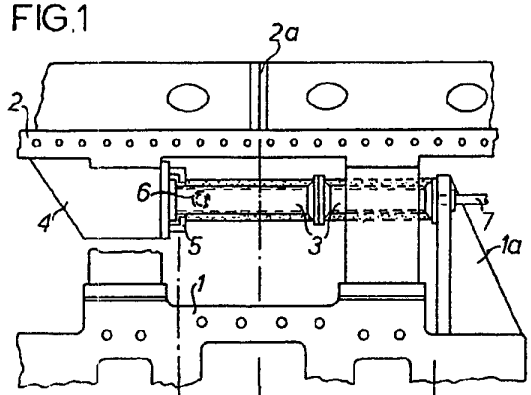

FIG.2

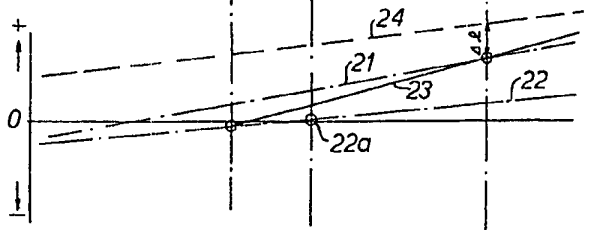

FIG.3

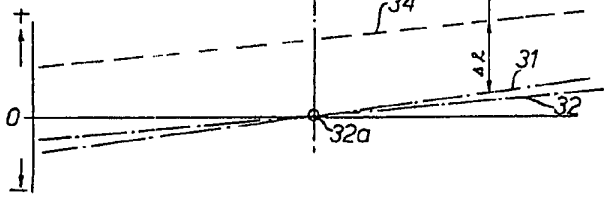

FIG.4

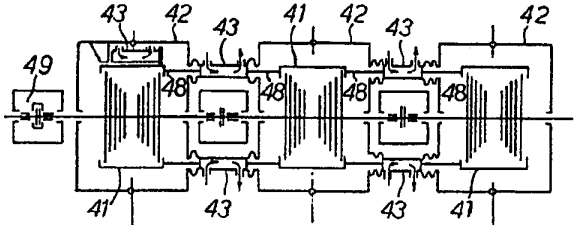

FIG.5